Final Report

Student Internship Program (SIP)

Organization: SMEC
Locations: SMEC HQ [Anabil Tower, 8th Floor, Plot-03, Block-NW(J), Kemal Ataturk Avenue, Gulshan-2, Dhaka-1212, Bangladesh], Dhaka WASA Bhaban [15th floor, Kazi Nazrul Islam Ave, Dhaka-1215, Bangladesh]
Period: 2026-05-17 to 2026-06-03
Office Hours: 10:00 AM – 02:00 PM

Group: 06
Student IDs: 202330010, 202330021, 202330026, 202330044, 202330048, 202330057
Supervisors: Maj Ahadul Islam, Lec Tasnim

Overview

This report outlines the academic and practical activities completed during our Student Internship Program (SIP) at SMEC. We were initially assigned to the Dhaka Sanitation Improvement Project's (DSIP) Project Management Consultant office based at the Dhaka WASA Bhaban. Then, we took a short tutorial on SMEC's other major projects' overview, challenges, and mitigation techniques. The overall activity included technical document reviews (terms of reference and progress reports), a field visit to the Pagla Sewage Treatment Plant (PSTP), direct interactions with consulting engineers, and participation in tutorials. We observed how major civil and environmental engineering projects are planned, managed, and constructed.

Chronological Activities

Date	Location	Summarized Activity
2026-05-17 (Day 01)	SMEC HQ	Orientation, introduction, review of SMEC's history, and project assignment.
2026-05-18 (Day 02)	Dhaka WASA Bhaban	Introduction to the Sewerage Master Plan, its 5 catchments, technologies, and structure of funding through World Bank and AIIB.
2026-05-19 (Day 03)	Dhaka WASA Bhaban	Study of the project's Terms of Reference (ToR). Discussed government tendering processes and consultant-contractor divisions of labor.
2026-05-20 (Day 04)	Dhaka WASA Bhaban	Desk study session, group discussions, and preparatory briefing for the upcoming field visit.
2026-05-21 (Day 05)	Dhaka WASA Bhaban, Pagla STP	On-site inspection of Pagla STP's construction plant. Attended a safety briefing, reviewed construction design schematics, and examined the overall process.
2026-05-23 (Day 06)	Dhaka WASA Bhaban	Peer discussion with each other.
2026-05-24 (Day 07)	Dhaka WASA Bhaban	Study of Quarterly and Semi-Annual Progress Reports. Analyzed indicator tracking tables, financial budgets, and risk mitigation strategies.
2026-06-01 (Day 08)	Dhaka WASA Bhaban	Team photoshoot and project briefing. Understood PMC's duty on project delays and social safeguards.
2026-06-02 (Day 09)	Dhaka WASA Bhaban	Performance evaluation and technical QA session with senior members.
2026-06-03 (Day 10)	SMEC HQ	Presentation on Hydrology & River Training and construction overview and challenges on Padma Bridge, Karnaphuli Tunnel, and Jamuna Railway Bridge.

In-Depth Overview

1. Dhaka Sanitation Improvement Project's (DSIP) Overview

DSIP is part of the "Sewage Master Plan" prepared by DWASA in 2014. It divides the Dhaka city into five catchments:

i) Pagla Catchment
ii) Dasherkandi Catchment
iii) Uttara Catchment
iv) Mirpur Catchment
v) Rayerbazar Catchment

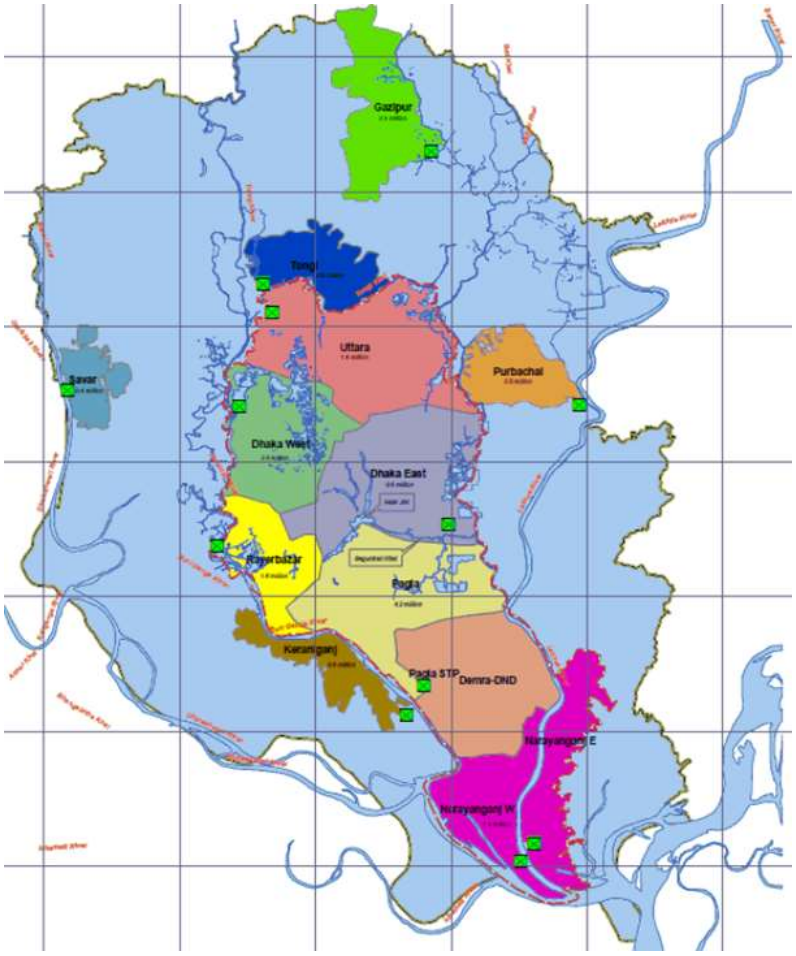


Figure 1 Map of Project (DSIP) Area

Currently, Phase-I is being implemented in Pagla Catchment. The Pagla Catchment is composed of 3 main trunk sewer lines (22 km), over 400 km of intercepting mains, with service capacity to support approximately 1.5 million urban residents. The project is being co-funded by loans from Asian Infrastructure Investment Bank (AIIB) and World Bank.

The realization of this project is based on the sludge management deficiencies currently present. Only about 20% of Dhaka's fecal sludge is being treated. This treatment is limited to chemical dosing for odor reduction prior to river disposal. The completed DSIP network aims to replace this method with a comprehensive and modernized treatment.

1.1. Document Review: Terms of Reference (ToR)

An analysis of the ToR highlighted the complex parameters of managing large-scale public projects. Public projects need to ensure that every scope is in-check; progress is reported accordingly including physical, financial, and procurements. As such, a rigorous ToR is produced against which consultant firms check the works of contractors.

The ToR breaks down the DSIP (project) into five components. It clearly delineates which unit or organization is responsible for which components. It does so by further breaking down the project into eight work packages, five service packages, and several goods packages. The work packages are composed of implementation scope of contractors; the service packages are of consultancy scopes; and goods packages are of procurement scopes.

The ToR defines the total lifespan of this project (60 months, Pagla catchment area timeline spanning 40 months). It also allocates human resources (a total of 193 personnel, with around one-third consisting of international experts). Studying the ToR reflected the recruitment and staffing criteria to be: a bachelor's degree is the minimum academic requirement, and substantial experience (ranging from 10 to 20 years) is highly prioritized for senior roles.

The responsibilities of our interning office [Project Management Consultant (PMC)] are clearly described by the ToR. It is responsible for component 2 (Institutional Support for Sanitation Service Delivery) and component 4 (Project Implementation and Management Support) of the project. It will accomplish these responsibilities as part of SD2 service package, which is responsible for:

i) Task A: Mobilization and inception
ii) Task B: Contract management and coordination support to DWASA
iii) Task C: Project planning, monitoring, and evaluation support
iv) Task D: Institutional strengthening support
v) Task E: Gender Action Plan (GAP) - preparation and implementation
vi) Task F: Training program for DWASA
vii) Task G: Project reporting

In short, the consultant shall prepare overall planning schedules for the completion of DSIP that cover all components and activities needed for the proposed project. It will also track any progress or delays made under the project.

1.2. Document Review: Project Progress Reports

The PMC generates monthly, quarterly, semi-annually, and annual progress reports. Generally, the structure of the reports is:

i) Background
ii) Methodology
iii) Physical Progress of Project
iv) Social, Resettlement, Environmental, and Gender Issues
v) Financial Progress
vi) Identification of Problems
vii) Conclusion
viii) Recommendation

Project execution progress is monitored and recorded across three main dimensions:

i) Physical progress: Tracked using Indicator Tracking Table. Activities are categorized into:
    a) Service packages: e.g., SD2 (Consultancy services).
    b) Work packages: e.g., WD3 (Construction of the Western Main Trunk line).
    c) Goods packages: e.g., Procurement of office vehicles and utility bikes.
ii) Financial progress: Assessed by comparing actual project expenditures against the planned budget.
iii) Social work progress: Monitored by measuring resolved social, resettlement, and environmental issues against the initial list of anticipated challenges.

An example of work package progress is as follows:

Package	Capacity/Length	Progress
WD2 (Design and Build Contract for reconstruction of Eastern trunk main)	12 km (Micro tunneling 6 km & open cut 6 km)	• Preliminary design: Ongoing (partly approved [WA & WB. Modhubag to Golapbagh & Golapbagh to Doyaganj Mor]) • Detailed design for WA section: First 6 km approved on July 8, 2024 and road cutting permission for 4.5 km was received from DSCC on March 25, 2025. • Road cutting permission for 0.5 km was received from DNCC on September 4, 2025. • Shaft construction work of WA section: 2 & 3 is going on. • Shaft no. 33 – construction completed. • Shaft no. 30, 31, 34 – construction on going. • Detailed design for WB section: Submitted. • Detailed design for WC section: Not yet submitted. • Golapbagh SPS design work: Detailed design approved and earth excavation ongoing.

Similarly, service packages would layout table formatted progress with item such as “Quarterly report (July to September 2025): Submitted on November 16, 2025.”.

The reports determine financial progress as:

$$Financial\ Progress\ (\%) = \frac{Release\ of\ Fund}{Contract\ Price} \times 100$$

For instance, the financial progress during July 2023 to January 2026 is:

	Contract Price in BDT	Release of Fund in BDT	Financial Progress (%)	Total Financial Progress (%)
BDT	223,004,774.38	92,553,056.00	41.49	30.02
USD	1,353,100.00	196.332.81	14.51	

The report also includes obstacles and their mitigations. Such as coordination gaps between consultants and contractors and a major cause of delayed report generation. Mitigation plan would be to encourage contractors to make breakdown of their activities in proper time.

1.3. Pagla Sewage Treatment Plant (STP) overview

1.3.1. Background

The Pagla Sewage Treatment Plant (PSTP) is the oldest and largest centralized sewage treatment facility in Dhaka. The plant was initially commissioned in 1968 with four facultative lagoons to serve approximately 500,000 residents of the city. In 1977, the facility underwent renovation to improve its operational performance. Subsequently, with assistance from the Japan International Cooperation Agency (JICA), the treatment plant was rehabilitated in 1992 and upgraded to treat a design capacity of 120,000 m^3/day.

The treatment plant occupies an area of approximately 110.5 hectares. The current design capacity of the facility is 96 million liters per day (MLD) under average flow conditions and 120 MLD under peak flow conditions. However, the sewage generated within the catchment area served by the centralized sewerage system is estimated to be approximately 250–300 MLD at present and is projected to exceed 500 MLD by 2035 according to the Sewerage Master Plan.

1.3.2. Plant Layout and Land Use

Approximately 80% of the total land area is occupied by treatment facilities, including oxidation lagoons, sludge holding lagoons, sludge drying beds, inlet works, and primary treatment units. The remaining 20% of the area comprises the central stockyard of Dhaka WASA Stores Division, administrative offices, storage buildings, staff housing facilities, internal roads, and open spaces.



Figure 2 Aerial view of Pagla STP

1.3.3. Existing Treatment Process

The Pagla Sewage Treatment Plant is designed to operate as an eight-lagoon facultative lagoon system. Each treatment module consists of a facultative lagoon followed by a maturation lagoon. The average hydraulic retention time for each module is approximately 48 hours, allowing for biological stabilization and treatment of wastewater before discharge.

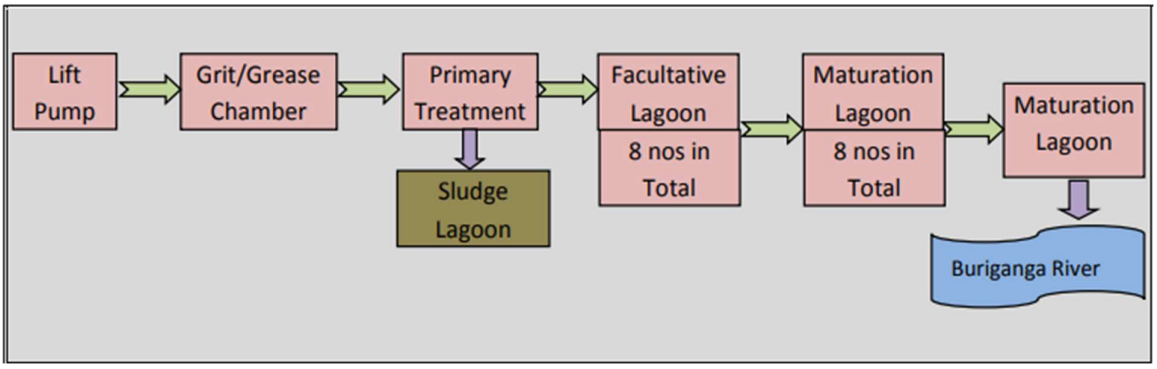


Figure 3 Summary of existing facultative lagoon treatment process diagram

1.3.4. Existing Operational Challenges

Despite its historical significance and contribution to wastewater management in Dhaka, the existing treatment system faces several operational challenges. The overall treatment process lacks effective integration between sewage treatment and sludge management components. In the current arrangement, sludge accumulated within the primary treatment facilities cannot be conveniently conveyed to the sludge drying beds through gravity flow or pumping systems without interrupting plant operations and carrying out desludging activities.

Under the conventional facultative lagoon concept, most sludge is expected to settle within the facultative lagoons, while smaller quantities settle in the maturation lagoons. A limited amount

of suspended solids may pass through the treatment process and leave with the treated effluent. With the introduction of primary treatment facilities, larger quantities of sludge are retained at the preliminary stages of treatment. Consequently, the need for dedicated sludge storage and handling facilities, such as sludge holding lagoons, becomes increasingly important for efficient plant operation and sludge management.

1.3.5. Development of Pagla STP

Considering the increasing wastewater generation within the Pagla sewerage catchment area and the limitations of the existing treatment facilities, Dhaka WASA has undertaken a major reconstruction and expansion initiative under the Dhaka Sanitation Improvement Project (DSIP). The existing treatment plant will be replaced by a new sewage treatment facility with a planned capacity of approximately 250 MLD. Since the new plant will utilize the land occupied by the existing treatment works, rehabilitation while maintaining operation of the existing plant is not considered feasible.

The Phase-I investment plan has been developed to establish a strong foundation for future expansion and to meet the long-term objectives outlined in the Sewerage Master Plan. The upgraded facility is intended to serve an ultimate population of approximately 6 million by the year 2035. To accommodate future demand, several treatment units are being designed with provisions for long-term expansion.

The major components of the proposed treatment plant include:

i) Inlet works and lifting station
ii) Screening, grit and grease removal facilities
iii) Distribution chamber
iv) Anoxic tanks
v) Aeration tanks
vi) Final clarifiers
vii) Sludge management facilities

The project is being implemented by VA Tech Wabag Ltd., and the overall construction progress was reported to be approximately 32% at the time of the visit.

1.3.6. Conventional Activated Sludge Process (CAS)

The reconstructed Pagla STP will employ the Conventional Activated Sludge (CAS) Process, one of the most widely used biological wastewater treatment technologies. The process consists primarily of an aeration tank and a secondary clarifier.

In the aeration tank, wastewater is mixed with air to promote the growth of microorganisms that consume and degrade organic pollutants. As biological treatment proceeds, the microorganisms form larger particles known as flocs, which enhance the removal of biodegradable contaminants. The mixed liquor then flows to the secondary clarifier, where the biological flocs settle and are separated from the treated water.

The treated effluent is subsequently discharged after meeting the required environmental standards, while the settled sludge is transferred to the sludge treatment system for further processing. During the site presentation, the treatment sequence was explained as:

Screening → Aeration → Sedimentation → Sludge Thickening → Digestion → Biogas Production

An important feature of the proposed plant is the utilization of biogas generated during sludge digestion for electricity production. The generated power is expected to meet a significant portion of the plant's operational energy demand, with surplus electricity potentially supplied to the national grid.



Figure 4 Proposed reconstructed view of Pagla STP

2. Other Major Project's Handled by SMEC

2.2. Jamuna Railway Bridge

The Jamuna Multipurpose Bridge, officially known as the Bangabandhu Bridge, was the first major fixed crossing over the Jamuna River in Bangladesh. Opened in 1998, the bridge significantly improved transportation, trade, and communication between the eastern and western regions of the country. Due to the highly braided nature of the Jamuna River, extreme scour potential, and poor near-surface soil conditions, the bridge required an advanced deep foundation system.

To further enhance railway connectivity, the Jamuna Railway Bridge was constructed parallel to the existing bridge and became operational in 2025. The new railway bridge was designed to accommodate higher train speeds, increased traffic volume, and modern railway loading requirements. Comprehensive geotechnical investigations and advanced foundation solutions were essential for both projects.

2.1.1. Geological and Soil Conditions

The Jamuna River is one of the world's largest braided rivers and carries enormous sediment loads during the monsoon season. Geotechnical investigations revealed that the riverbed consists predominantly of loose to medium-dense micaceous sand deposits extending to significant depths. Approximately 70 meters of loose to medium-dense sand layers were encountered beneath the riverbed, presenting major challenges for foundation design.

The soil profile generally consists of:

i) Surface layers of silty sand and sandy silt.
ii) Thick deposits of loose to medium-dense fine sand.
iii) Deeper layers of dense sand capable of providing adequate bearing capacity.
iv) High groundwater levels and continuous sediment movement.

The river's strong flow and sediment transport create severe scour conditions, requiring foundations to extend well below the anticipated scour depth. Deep foundations were therefore selected to ensure long-term stability and safety.

2.1.2. Foundation System of Jamuna Bridge

The Jamuna Bridge is supported by tubular steel piles driven deep into the riverbed. A total of 50 piers support the main bridge structure. The foundation system consists of large diameter steel tubular piles ranging from 2.5 m to 3.15 m in diameter. These piles were driven to depths approaching 80 m below the riverbed to reach more stable soil layers.

The foundation arrangement includes:

i) 21 piers supported by groups of three steel piles.
ii) 29 piers supported by groups of two steel piles.
iii) Concrete-filled steel tubular piles.
iv) Reinforced concrete pile caps connecting the pile groups.

The pier stems were constructed above the pile caps and equipped with bearings and seismic protection devices. These devices allow controlled movement under normal conditions while providing resistance during earthquake events.

2.1.3. Jamuna Railway Bridge Foundation and Structural Features

The Jamuna Railway Bridge was constructed adjacent to the original bridge to provide a dedicated railway crossing. The bridge spans approximately 4.8 km and carries a dualgauge double-track railway system. It was designed to support significantly higher train frequencies and speeds than the railway track previously carried on the Jamuna Multipurpose Bridge.

Extensive geotechnical investigations were performed to account for the river's hydraulic behavior, sediment transport, and foundation requirements. Weathering steel was used in the bridge structure to reduce maintenance requirements and improve durability in Bangladesh's humid environment. The bridge foundations were specifically designed to resist flood-induced scour and riverbed migration.

2.1.4. Engineering Challenges and Innovations

2.1.5. Severe Scour

The Jamuna River experiences significant riverbed erosion during flood seasons. Foundation depths were selected to ensure structural safety even under extreme scour conditions.

2.1.6. Weak Sandy Soil

Loose and medium-dense sandy deposits dominate the subsurface profile. Deep pile foundations were required to transfer loads to more competent soil layers.

2.1.7. Seismic Loading

The bridge lies within a seismically active region. Special bearings and seismic restraint systems were incorporated into the design to improve earthquake resistance.

2.1.8. Hydraulic Forces

Strong river currents generate substantial lateral forces on bridge piers. Large-diameter tubular piles and robust pier systems were used to resist these loads.

2.1.9. Durability Requirements

The Jamuna Railway Bridge utilizes weathering steel technology to minimize corrosion and reduce long-term maintenance costs.

2.1.10. Findings and Discussion

The success of the Jamuna Bridge and Jamuna Railway Bridge demonstrates the critical role of geotechnical engineering in large river-crossing projects. Detailed subsurface investigations enabled engineers to identify suitable bearing strata and develop foundation systems capable of resisting scour, seismic forces, and hydraulic loading.

The use of deep steel tubular piles provided an effective solution for transferring structural loads through weak sandy soils into more stable underlying layers. The foundation systems have successfully supported both road and railway transportation while withstanding the challenging environmental conditions of the Jamuna River.

2.1.11. Conclusion

The Jamuna Bridge and Jamuna Railway Bridge represent major achievements in Bangladeshi infrastructure development. Both structures required sophisticated geotechnical investigations and innovative foundation designs due to the river's highly dynamic nature and challenging soil conditions. The adoption of deep tubular pile foundations, scour-resistant designs, and seismic protection systems has ensured the long-term stability and functionality of these nationally important transportation links. These projects provide valuable examples of how modern geotechnical and structural engineering can overcome complex river-crossing challenges.

2.2. Karnaphuli Tunnel

2.2.1. Background

The Karnaphuli Tunnel is the first underwater road tunnel in South Asia and one of the most significant transportation infrastructure projects undertaken in Bangladesh. The project was developed to improve connectivity between the northern and southern banks of the Karnaphuli River in Chattogram, the country's principal port city. Since the river serves as an important navigation channel for maritime transportation, the construction of a tunnel was considered a more suitable alternative than a bridge, allowing uninterrupted river traffic while enhancing regional road connectivity.

The total project length is approximately 9.3 km, including approach roads and tunnel sections. The tunnel itself is approximately 3.315 km long and forms a vital transportation link connecting industrial zones, port facilities, and the southeastern region of Bangladesh.

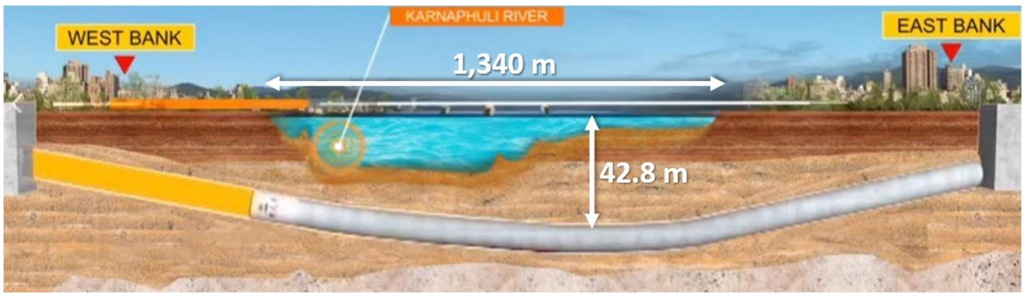


Figure 5 Illustration of the Karnaphuli River Tunnel and Riverbed Profile

2.2.2. Project Significance and Benefits

During the technical presentation, SMEC engineers highlighted several strategic benefits of the project. The tunnel substantially reduces travel distance and travel time between the two sides of the river, improving transportation efficiency and accessibility. The project is expected to support economic growth by facilitating the movement of goods and passengers, strengthening connectivity to industrial areas, and improving access to Chattogram Port.

The tunnel has been designed to accommodate significant traffic demand and is expected to serve as an important component of Bangladesh's future transportation network.

2.2.3. Tunnel Construction Methodology

The engineers provided a detailed overview of the construction process adopted for the tunnel. The project required extensive geotechnical investigations to assess subsurface conditions beneath the riverbed and to determine the most suitable tunnel alignment.

Tunnel excavation was carried out using a Tunnel Boring Machine (TBM), which enabled continuous excavation while maintaining stability of the surrounding ground. Following excavation, precast concrete lining segments were installed to provide structural support and long-term durability. Additional construction activities included waterproofing works, shaft construction, approach road development, and installation of mechanical and electrical systems.

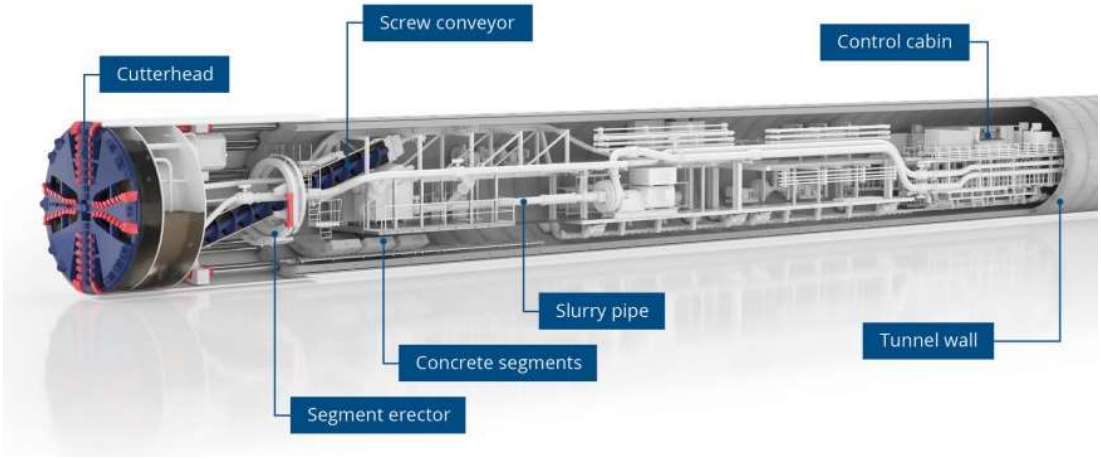


Figure 6 Tunnel Boring Machine (TBM) Diagram

The maximum excavation rate achieved by the TBM was reported to be approximately 20 meters per day, while the average excavation progress remained around 8 meters per day due to varying geological conditions and operational requirements.

2.2.4. Engineering Challenges and Ground Improvement Measures

The construction of an underwater tunnel beneath a major river presented numerous engineering challenges. Major concerns included groundwater pressure, tunnel alignment accuracy, excavation stability, and prevention of water infiltration.

Another significant challenge involved addressing seismic and liquefaction risks associated with the riverbed soils. To improve foundation stability and increase resistance against liquefaction, ground improvement techniques such as vibroflotation and gravel piling were implemented in susceptible areas.

These measures were essential in ensuring the long-term stability and safety of the tunnel structure.

2.2.5. Cross Passages and Safety Considerations

A notable feature of the Karnaphuli Tunnel is the inclusion of three cross passages located at approximately 700-meter intervals between the tunnel tubes. These passages serve as emergency evacuation routes and provide access for maintenance and operational activities.

The engineers explained that ground-freezing technology was utilized during the construction of the cross passages to stabilize the surrounding soil and create safe excavation conditions.

Comprehensive safety measures were implemented throughout the construction process, including continuous monitoring of excavation activities, settlement monitoring, emergency preparedness planning, ventilation systems, fire protection systems, and strict occupational health and safety procedures.

The incorporation of these safety measures ensured both worker protection during construction and operational safety after project completion.

Summary

The 10-day Student Internship Program provided a concise technical review of urban utility modernization and heavy infrastructure design frameworks. Through the engineering review of the Dhaka Sanitation Improvement Project (DSIP), the training detailed the execution of a multi-catchment municipal master plan, donor-financed management constraints, and trenchless tunneling operations. The site investigation at the Pagla Sewage Treatment Plant demonstrated the practical scaling of wastewater treatment capacity from standard waste stabilization ponds to a highly automated 200 MLD conventional activated sludge process featuring anaerobic gas co-generation and agricultural sludge processing loops.

Finally, the program concluded with advanced civil engineering modules highlighting hydrographic surveying systems and the mitigation of extreme geotechnical hazards - such as micro-fine soil grouting at the Padma Bridge, sub-river ground freezing at the Karnaphuli Tunnel, and deep hydrodynamic scour profiling for the Jamuna Railway Bridge.

Conclusion

In conclusion, this internship successfully bridged core academic engineering theories with complex, real-world execution boundaries. The exercises demonstrated that successful civil and environmental engineering projects require balancing pure hydraulic and structural designs with stringent project management frameworks, international reporting standards, and social safeguard policies. Navigating permit delays, fixed-loan limitations, and highly complex soil-structure conditions underscores the adaptive role of engineering consultants.